COMMONWEALTH OF PENNSYLVANIA.

DEPARTMENT OF AGRICULTURE.

BULLETIN No. 120.

THE APPLE-TREE TENT-CATERPILLAR

AND ITS

LIFE HISTORY.

By Nelson F. Davis, Sc. D.

PUBLISHED BY DIRECTION OF THE SECRETARY.

1903.

WM. STANLEY RAY,
STATE PRINTER OF PENNSYLVANIA,
1904.

VIRTUE LIBERTY AND INDEPENDENCE

PREFACE.

Commonwealth of Pennsylvania,
Department of Agriculture,
Harrisburg, Pa., December 31, 1903.

Every fruit grower knows that his success depends very largely upon his being able to combat successfully the insect pests with which he comes in contact. Some of these insects he is able to recognize at sight in certain stages of their development or life-history, while in other stages he fails to notice them or, seeing them has no knowledge of their identity.

Among the very destructive enemies of orchard fruits, especially the apple, is the Tent Caterpillar, which forms the subject of this bulletin, and the bulletin is published in the hope of assisting fruit growers in being able to recognize this enemy in whatever stage of his life-history he may be found, and in the further hope of encouraging them to apply the most efficacious methods for his destruction.

N. B. CRITCHFIELD,
Secretary of Agriculture.

LETTER OF TRANSMITTAL.

Bucknell University,
Lewisburg, Pa., December 30, 1903.

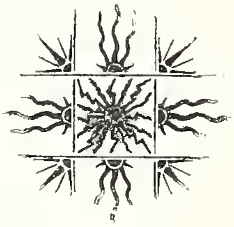
Hon. N. B. Critchfield, Secretary of Agriculture, Harrisburg, Pa.

Dear Sir: I submit herewith the copy for a bulletin on the Apple-tree Tent-caterpillar (Clisiocampa americana). The insect is well known to the entomologist and has been for centuries. The farmer in most cases, however, knows only the tent, not being able to identify the larva (caterpillar) when removed from the tent.

It is an old and familiar pest and the farmer well knows its ravages in neglected orchards, and yet very little is done to check its progress. Generally it is let alone, where, fortunately, its natural enemies keep it in check. However there are years when thousands of trees in our State, especially wild-cherry and apple, are entirely defoliated. Such a year was 1898.

The farmer neglects this pest until it is too late. In spite of repeated publications, the habits of the insect are still unknown to him. The purpose of this bulletin is to acquaint him, by means of photographs and descriptions, with the complete life-history, food, enemies, and habits of the insect, trusting that he may thus be led to know the several stages from eggs to adult moths wherever and whenever they are found. The photographs were taken by myself during the years 1902 and 1903. They are typical, being selected from over one hundred colonies upon which these observations were made.

NELSON F. DAVIS,
Professor of Biology, Bucknell University.



THE APPLE-TREE TENT-CATERPILLAR AND ITS LIFE HISTORY.

By NELSON F. DAVIS, Sc. D.,
Professor Biology, Bucknell University, Lewisburg, Pa.

ORDER, LEPIDOPTERA: FAMILY, LASIOCAMPIDAE:
GENUS, CLISIOCAMPA: SPECIES, AMERICANA. FABR.

The life-history and habits of the Apple-tree Tent-caterpillar are well known to all entomologists. When Spring comes, and usually about three days before the leaf-buds open, the larvæ (caterpillars) leave the eggs which are laid in glistening bands (Fig.1) that nearly or quite encircle the smaller twigs of the tree, the leaves of which are to furnish their food.

The egg-masses are deposited by the moth during the previous June or July and are at once covered by a glutinous secretion which, on exposure to the air, soon hardens and so protects the eggs from harm. During July, August, and September, each egg develops into a caterpillar, which, though still within the egg-capsule, or shell, is ready to hatch out as soon as warm weather comes. I have known them to hatch out after several warm days in November. These, however, soon perished.

As a rule the caterpillars do not leave the egg-cases until two or three days before the leaves open in the Spring. In Pennsylvania this occurs about the last of March or first of April. The covering of the eggs seems to be the first food of the young caterpillars. After eating their way out of the eggs the little creatures soon dry off, if the day is clear, and their first act is to spin a silken thread which is attached to the egg-mass and usually they are off searching for food within a few hours. The silken thread is left behind wherever they go. The first trip is usually up (in 90 cases out of 100 recorded) where they soon find a bud about to open. If it has opened enough to allow them to enter they at once begin to feed. If the weather becomes wet and cold after hatching, the little fellows may live for a period of from ten to twelve days; but most or all of them perish in fourteen days if these conditions have been continuous.

At this time the caterpillars have no tent (Fig 3) and so are exposed to the elements. When first hatched they are nearly black and about three-sixteenths of an inch long, one hundred and fifty to three hundred hatching from each cluster of eggs.

If the weather is warm the second day after hatching, the caterpillars begin to construct their home, which is in the form of a silken tent so well known to the farmer. One tent begun by a colony on the second of April, 1903, by April 6th showed six or seven layers of silk (Fig. 5) and was then plainly visible although about twenty feet high, on a wild-cherry tree. (This is the best time to destroy the pest, which can be done by cutting off the branch and burning it). In spinning the tent several openings are left, through which the caterpillars go in and out of their home (Fig. 11).

The caterpillar grows by moulting: i. e., when the skin becomes too tight it splits open down the back for a short distance from the head and the caterpillar works its way out, clothed in a new skin which is of a lighter color. This new skin is very soft and while in this condition the caterpillar grows rapidly. The day before moulting the caterpillars rest in their tent. After moulting they remain in the tent for several hours and then go out to feed. Five times during the life of the caterpillar it sheds its skin, or moults. The fifth moult occurs after the cocoon is finished, and when the last skin is shed the pupa is fully formed (Fig. 15).

The time from one moult to another differs greatly in different colonies and also in the individuals of the same colony. The length of time depends on the food-supply and on the temperature. Ten colonies recorded in 1903 moulted as follows: April 2d, caterpillars hatched; the first moult occurred in all colonies on April 7th; the second from the 14th to the 17th; the third from the 20th to the 28th; the fourth from the 1st of May to the 6th; and the fifth, inside the cocoons, from May 14th to the 22d.

When full grown the caterpillars measure from two inches to two and one-half inches in length. The appearance and natural size of the caterpillars, before and after each moult is well shown in the photographs, so no attempt will be made to describe them.

The first tent constructed is usually near the end of the branches, but this one is soon abandoned, usually before the second moult, and the caterpillars seek a place where several larger limbs of the tree come together, forming a crotch. Here a new tent is quickly constructed and in two or three days it is of considerable size (Fig. 18).

The caterpillars leave the tent early in the morning, if it is not too cold, and are soon scattered over the tree, following trails of silk, if they have been on the limb before. If they are compelled to seek food on new limbs they go slowly and cautiously, leaving behind a trail of silk. By means of this trail they can return to the tent. After a few trips the new trail is well established, and now the caterpillars will follow it without spinning as they go. When compelled to turn out for a fellow coming in the opposite direction, they must leave the path, or cling only to the edge of it, and as they do so they spin a thread, and thus the trail gradually becomes wider. In this way the trail may finally cover the smaller branches. Some may feed at almost every hour of the day, but in fair weather they usually feed for a time in the early morning, again in the early afternoon, and once or twice during the night. In rainy weather they may remain in the tent all day. During fair cold weather they go inside the tent immediately after feeding and do not spin. If fair and warm they usually spin for half an hour or longer when all rest for a time. Some may go inside, but if it is very hot nearly all will seek the shady side of the tent and stay on the outside. If somewhat cool all will seek the sunny side.

When spinning the caterpillars move their heads from side to side as they crawl and attach their silken threads first on one side, as far as they can reach, then on the other. The tents are composed of a series of layers of silk (Fig. 12) with just room enough between for the caterpillars. The new layer is usually begun at the edges by a few individuals which first build a framework from the limbs to the last layer of silk, and finally such a firm scaffold is made that it is actually a new layer begun (Fig. 11). Sometimes they are aided in their work of building a new layer, by being allowed to crawl over the backs of their resting companions, but this is not necessary, nor is it the usual method. The framework or scaffold is left between the newly formed layer and the old one where it may remain for several days; but finally it is practically all destroyed. Five or six caterpillars will begin and finish a new layer, if all the other caterpillars are removed from the nest or tent. Frequently the caterpillars will crawl over the tent in a leisurely manner, not spinning, but apparently looking for a comfortable place to rest.

If at any time during the growth of the caterpillars the food-supply, which consists of leaves (and blossoms) is exhausted, they will leave the tree and wander in search of a new supply. If this occurs before the fourth moult a trail of silk is left behind (Fig. 19) and they wander aimlessly about until by chance more food is found. The new food may not be the same as the old, but they will feed on any of the following: Cherry, apple, peach, pear, quince, plum, hawthorn, or, in fact, any tree belonging to the Rose family. They will, if forced to do so, feed upon oak, mountain-ash, elm, willow, poplar, maple, and no doubt upon many other trees.

After the fourth moult they never build a new tent when arriving on a new tree. Before the fourth moult they may or may not. Fig. 23 shows a colony which wandered in search of a new feeding ground before the fourth moult. No tent was made. The weather was cold (22° F.) and many perished on the post. They had wandered from the tree shown in Fig. 18.

After the fourth moult the caterpillars cease to build their tent larger, and now they very seldom spin unless in search of food. Their tent soon becomes dilapidated, and as the caterpillars become full grown many forsake the tent and wander singly in all directions, not feeding at all and not leaving a silken thread behind them. They are now ready to spin their cocoons and do so, as soon as a suitable place can be found (Fig. 14). Thus the caterpillars soon become scattered, some frequently travelling a distance of two hundred yards. This scattering of the cocoons renders them less likely to be destroyed by birds or other enemies. Usually several remain in the old tent and spin their cocoons there. Others place them under the loose bark of trees, or in sheltered places under rocks or around buildings. In June the Baltimore oriole may be seen searching for these cocoons, which are quickly picked open and the pupæ devoured.

Within the cocoons the caterpillars moult for the last, or fifth time (about forty-eight hours after beginning to spin the cocoon). The cocoon is composed of silken threads among which is a dry powder resembling sulphur in appearance. Immediately before spinning its cocoon the caterpillar voids all matter from the alimentary canal, and soon after begins to shorten itself. During the spinning of the cocoon the contraction goes on (Fig. 15) until the caterpillar is finally about one inch long. The caterpillars which will develop into female moths are larger than those which will develop into males. In the cocoons the caterpillars change from larvæ to pupæ.

The adults hatch from the cocoons in about three weeks and are stout-bodied, hairy, brownish or buff-colored moths of medium size, with two parallel oblique lines across the fore-wings (Fig. 16). The male moth is smaller than the female and his antennæ are more feathery in appearance. The moths soon perish, as their mouth-parts are so degenerated that they cannot feed. Some may live a week, others perish in three days. Eggs are laid by the female the second or third day after emerging from the cocoon.

DISTRIBUTION.

Clisiocampa americana is distributed throughout the Eastern United States and Eastern Canada.

INJURY.

The injury caused by this insect varies from year to year. It is usually confined to wild-cherry and apple. A vigorous tree will be affected but little by one or two colonies, but frequently so many are present that the entire tree is defoliated. All the energies of the tree are now devoted to putting forth new leaves, and no fruit will develop during the season. The next spring may show many dead limbs on the trees as a result of this struggle (Fig. 26). Peach, plum, rose, birch, oak, maple, hawthorn, shad-bush, elm, willow, poplar, and probably many other trees, are occasionally attacked by them. In Northumberland County, this State, during 1898, hundreds of apple orchards were completely defoliated, every tree having from five to twenty colonies on it. Many empty tents were burned by the farmers after all damage had been done (Fig. 24).

ENEMIES.

The caterpillars are usually kept in check by their natural enemies. In 1903, throughout Pennsylvania, New York, and New Jersey, the caterpillars were attacked by a parasite, which is either a bacterium or a fungus. It killed them off by thousands (Fig. 27). From twelve infected colonies only ten healthy moths were obtained.

Among the true parasites which occasionally attack this caterpillar are the following: Pimpla pedalis, Pimpla conquisitor, Pimpla annulipes, and Theronia melanocephala.

Several species of beetles will attack them when the caterpillars are on the ground, as they may be when seeking a place to spin their cocoons.

Some of the vertebrate enemies are toads and frogs, which will devour them by the dozens, whenever the opportunity presents itself, and several species of birds, among which are the following, well-known to almost everyone: Yellow-billed cuckoo, black-billed cuckoo, crow, robin, Baltimore oriole, chickadee, and the vireos.

METHODS OF TREATMENT.

The best treatment for this insect is to destroy the egg-masses, while the trees are still leafless, in the Spring. A little practice will enable one to see them even on a large tree, where with long-handled pruning shears and a ladder they can easily be destroyed. March is the best month for this treatment. A few egg-masses will always be overlooked, so that it is necessary to go over the orchard again as soon as the leaves begin to open. Watch the orchard carefully until the remaining egg-masses have hatched out and the tents are begun (Fig. 5). Not a tent should escape this time.

The wild-cherry tree, so common in Pennsylvania, must be watched as closely as the apple, in any systematic attempt to exterminate this pest, or even to keep it in check. The caterpillars seem to prefer this tree to all others, and for this reason it seems advisable to cut down all the large trees near an orchard. The small trees may remain as lures, the egg-masses being removed from them each Spring.

If the orchard has been neglected until the caterpillars are of considerable size, the trees should be sprayed with one pound of Paris green to one hundred and fifty or two hundred gallons of water. This will kill the caterpillars in two or three days.

Do not use the torch, as many caterpillars will drop to the ground unharmed and escape. The flame will also injure the trees.

If it is desirable to spray the orchard early in the Spring for other insect pests the same application should be of sufficient strength to kill the tent-caterpillars also.

BIBLIOGRAPHY.

See the Report of the New York State Entomologist for 1898.

DESCRIPTION OF FIGURES.

Fig. 1. Egg-masses of Clisiocampa americana on apple. Eggs laid June 18, 1902. Photographed June 27, 1902. The branches of the apple are covered with the San José scale.

Fig. 2. Empty egg-masses on wild-cherry. Eggs laid June, 1901; hatched April 7, 1902; photographed April 2, 1903.

Fig. 3. The figure at the left shows an egg-mass, on wild-cherry, in which the caterpillars are just beginning to hatch. The right hand figure shows the caterpillars, one day old, just beginning to spin; some in the upper crotch others in the lower, just beneath the egg-mass. Length of caterpillars from 3-16—4-16 inch, April 2, 1903.

Fig. 4. On peach. A tent begun about the egg-mass was soon abandoned for the crotch below. Temperature 38° F. Caterpillars inside the tent. April 2, 1903.

Fig. 5. Tent on wild-cherry. Shows layers of silk. Buds covered by web entirely destroyed. Caterpillars inside tent. April 6, 1903.

Fig. 6. Colony at the right, on peach, shows trails of silk covering the limbs and egg-masses, and leading to the tent begun in the lower crotch. In colony at the left the caterpillars are moulting for the first time. The middle colony has completed the second moult. Tent shows openings to the interior. April 16, 1903.

Fig. 7. After second moult. The striped appearance is very marked. April 6, 1903.

Fig. 8. After third moult. The caterpillars are now very hairy, and show a distinct stripe down the back, with spots on each side. The excreta is shown in the tent. April 29, 1903.

Fig. 9. During the fourth moult. May 4, 1903.

Fig. 10. Full grown caterpillars. May 12, 1903.

Fig. 11. A typical tent, on wild-cherry. This shows how a new layer is started, by the caterpillars making a framework which gradually raises them up. Many of the supports are afterwards removed, mostly by accident. May 4, 1903.

Fig. 12. A tent on wild-cherry showing layers of which the tent is composed. May 4, 1903.

Fig. 13. Many caterpillars spun their cocoons in the tent. Side of tent removed to show cocoons. May 16, 1903.

Fig. 14. Cocoon in a protected spot. The moth emerged from this cocoon. June 17, 1902.

Fig. 15. From the larger cocoon a female moth emerged; from the smaller a male. Above are shown two pupæ removed from their cocoons. The one at the left shows the larval skin, or last moult, still attached. In the center on the right, a cocoon is cut open showing a caterpillar just before the last moult. At the left of this is an empty cocoon cut open. May 14, 1903.

Fig. 16. The adult moths. The two larger are females; the smallest is a male. May 30, 1903. These hatched out very early. During all of June and until July 7, 1903, living moths were collected.

Fig. 17. A wild-cherry tree attacked by Clisiocampa americana. May, 1902.

Fig. 18. Same tree as shown in Fig. 17. This photograph was taken about two days later, and shows how rapidly the leaves were devoured. Tents now empty. About 14 colonies had united in the larger tents.

Fig. 19. Shows base of tree, seen in Fig. 18. Trails of silk extend in all directions from the tree. Some followed the fence, others crossed the alley to peach, apple, and cherry trees. Many perished from starvation, not being able to find food.

Fig. 20. Distant view of same cherry tree and its surroundings.

Fig. 21. Failing to find food after wandering up and down the fence, on either side of the tree, hundreds spent the next two days on various fence posts. The photograph shows only one post. No tent was made as the caterpillars were preparing to moult. After about twelve hours they moulted for the fourth and last time before spinning their cocoons.

Fig. 22. After moulting, the caterpillars stayed on the post three or four hours and then moved on. The empty skins were all attached to threads covering the post, where they could be seen weeks afterward.

Fig. 23. Leaving the post shown in Fig. 22 the caterpillars found a wild-cherry tree, the branches of which touched the fence, about ten yards away. Here they found food. No tent was made. While here the temperature dropped to below freezing and many perished not having the protection of a tent. Only a few lived to spin cocoons.

Fig. 24. Three days after the caterpillars had left the tree the empty tents were burned. The photograph shows the blackened remains of the tents.

Fig. 25. The tree survived the effects of the caterpillars and put out new leaves but did not blossom. June 27, 1902.

Fig. 26. Same tree photographed a year after Fig. 25 was taken. Top of tree dead, probably from the effects of the burning of the empty tents, the previous year.

Fig. 27. During the spring of 1903, thousands of colonies of caterpillars in Pennsylvania, New York, and New Jersey were attacked by a disease, caused by bacteria or fungi, probably bacteria. The disease in some colonies killed every caterpillar before the third moult. Some lived to spin their cocoons (Fig. 28) only to perish in the end. A healthy colony was readily infected by spraying the leaves near the tent with water in which the caterpillars, dead from the disease, had been placed and broken up. Nine days after being infected every caterpillar of the colony was dead.

Fig. 28. Larvæ and pupæ dead from the effect of this disease. Attempts were made to cultivate the bacteria which were found in great numbers in the digestive tract of the caterpillars, but without success.

⁂

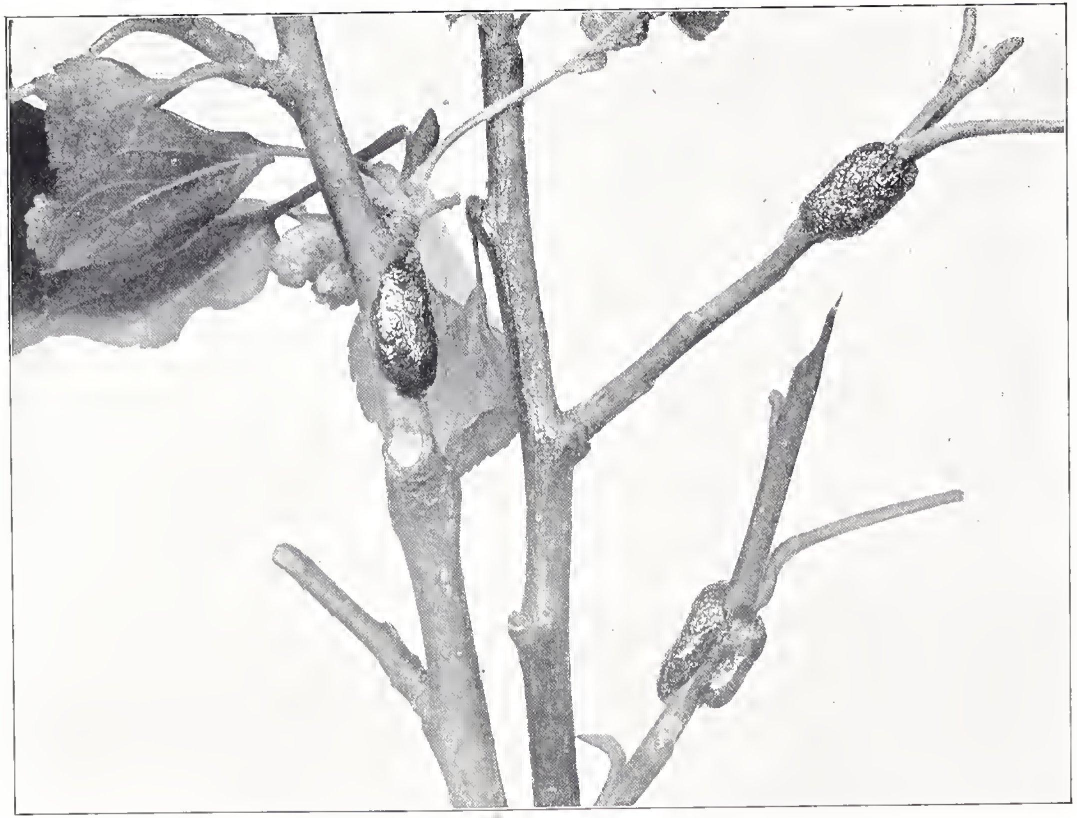


Fig. 1.—Eggs of Moth of Apple-tree Tent-caterpillar (Natural Size).

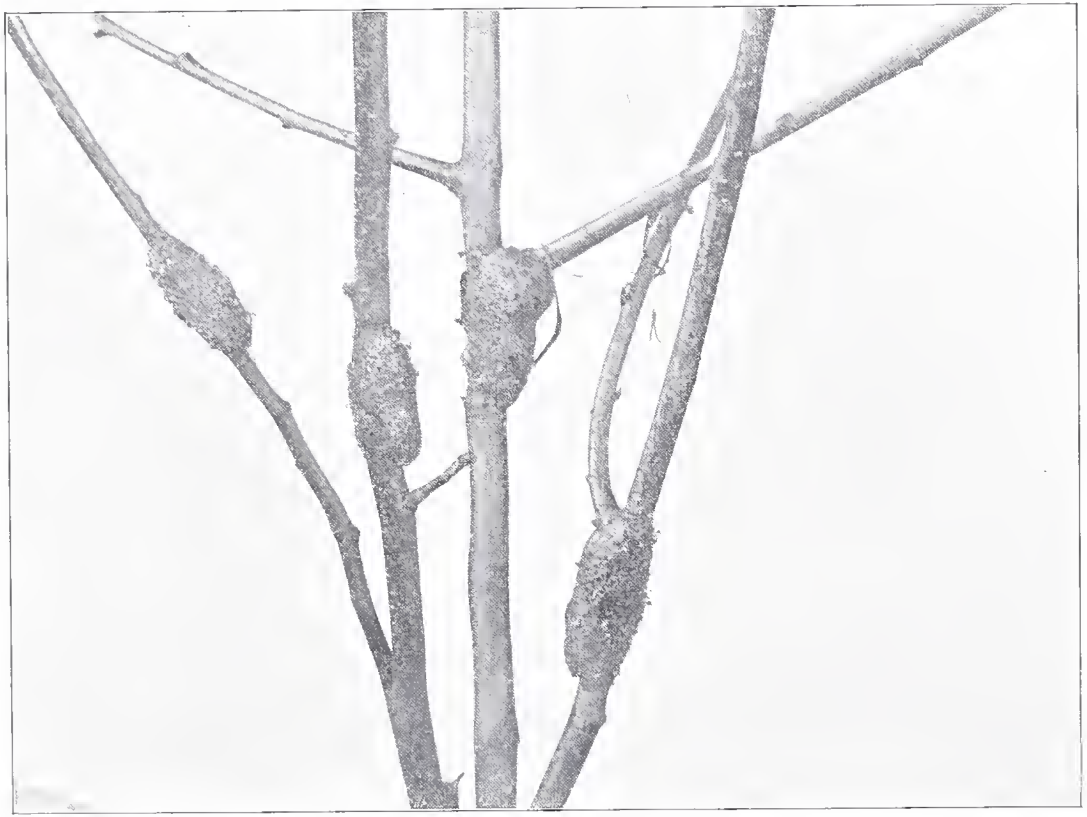


Fig. 2.—Empty Egg-cases (Natural Size).

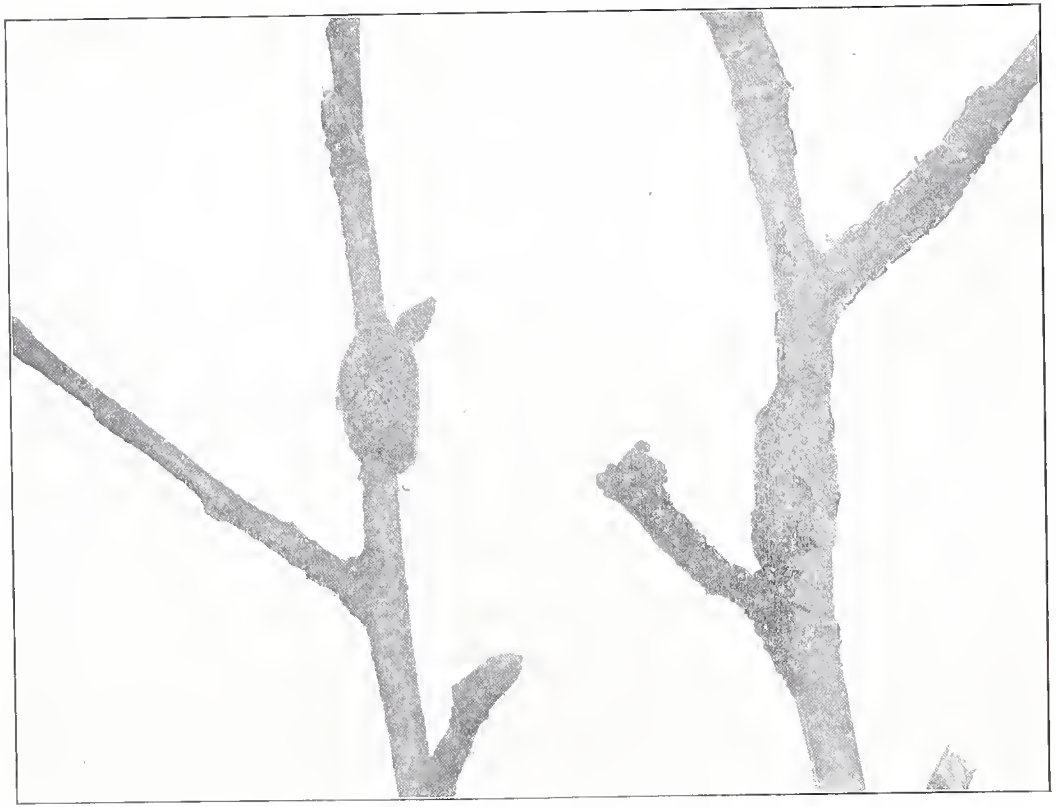


Fig. 3.—Caterpillars Hatching (Natural Size).

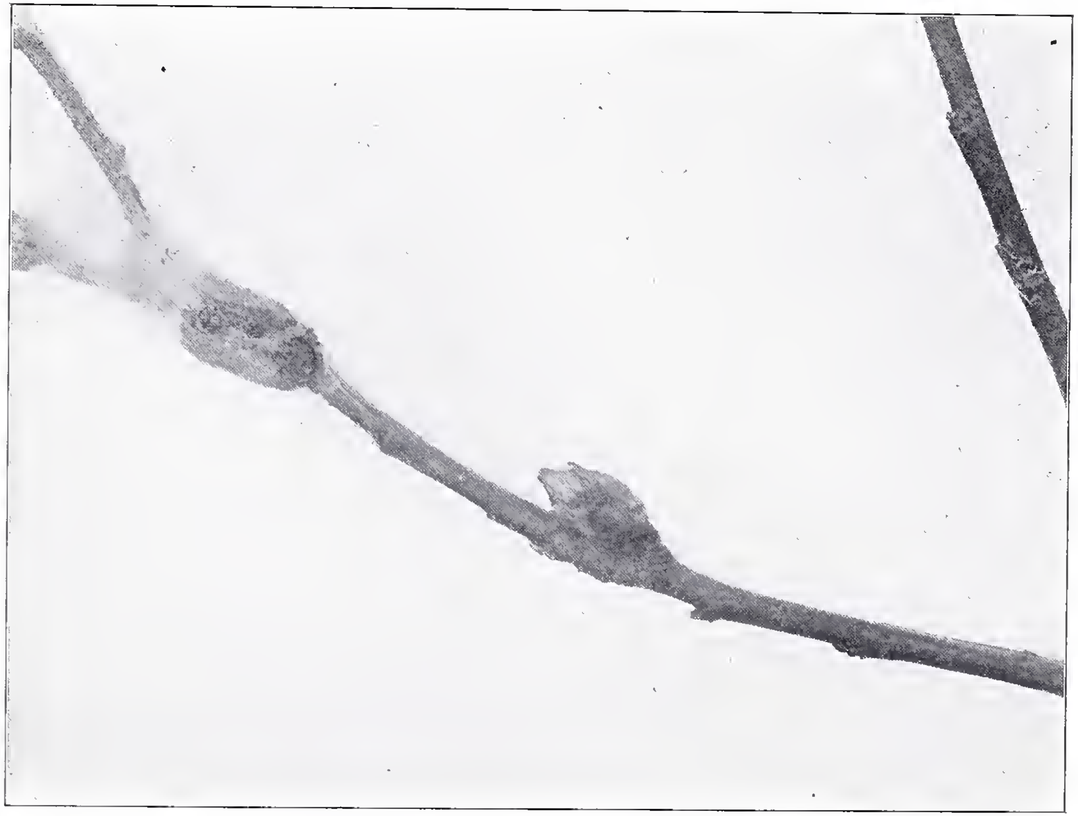


Fig. 4.—Caterpillars Beginning to Spin Tent (Natural Size).

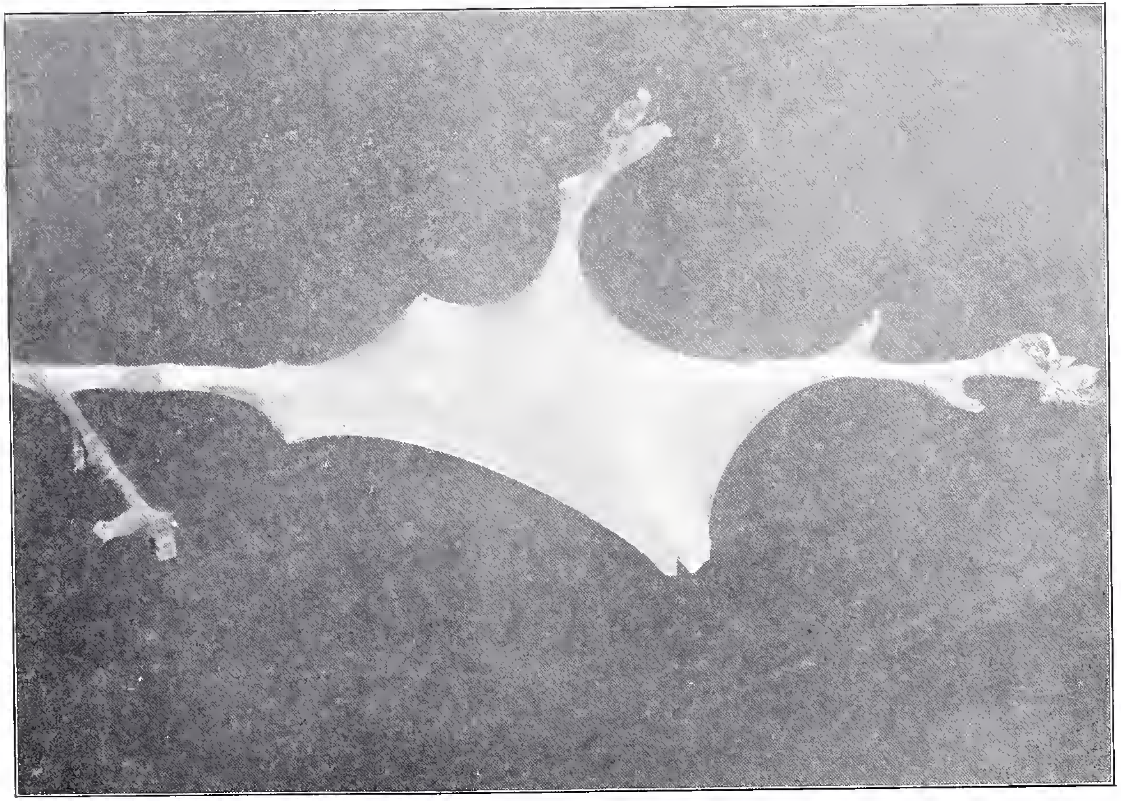


Fig. 5.—Tent of Young Caterpillars (Natural Size).

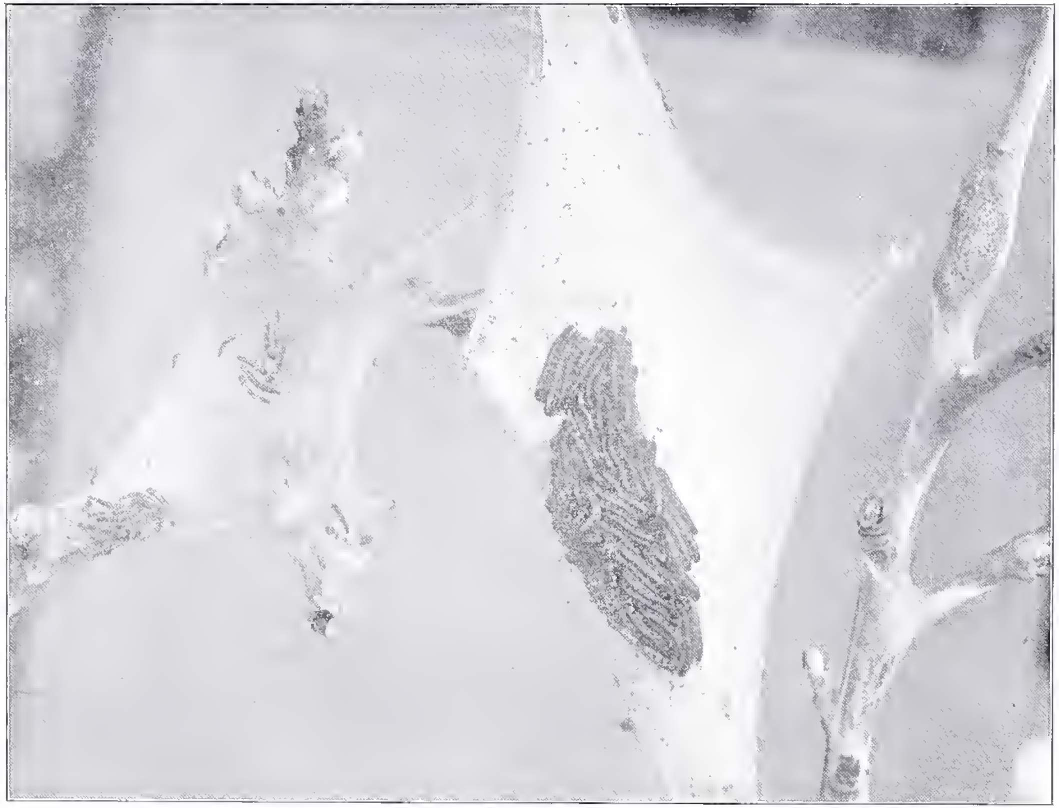


Fig. 6.—Immediately After First, and Before Second Moult (Natural Size).

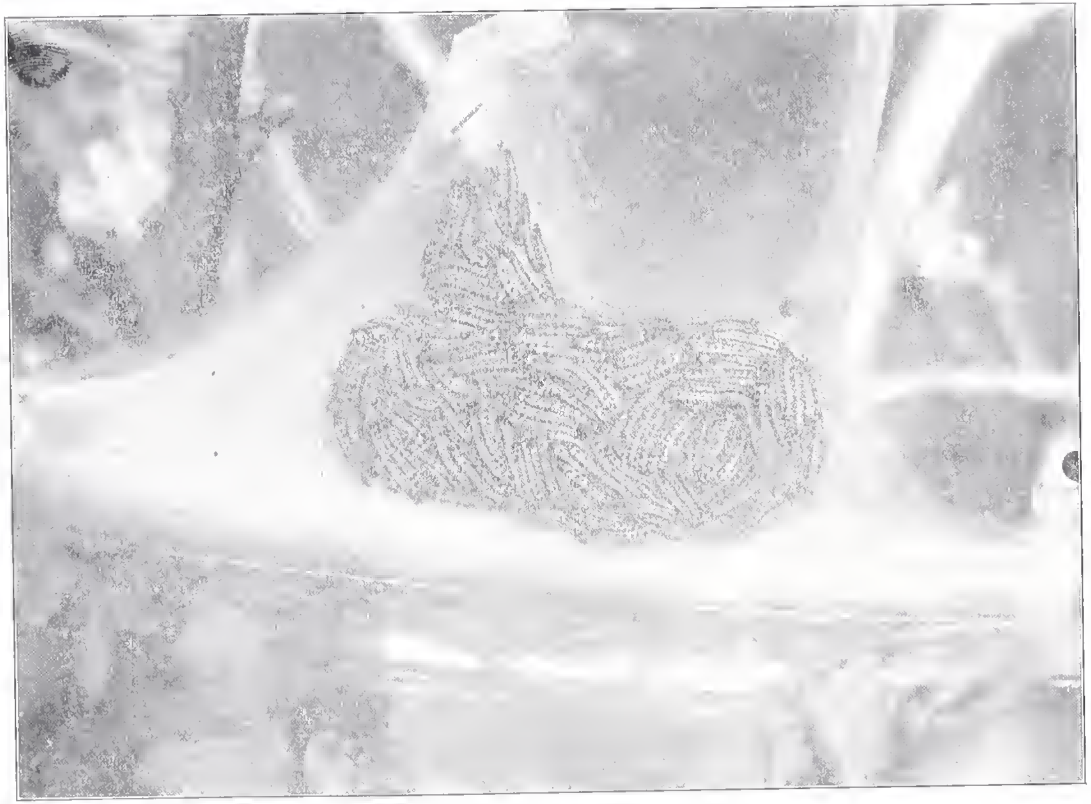


Fig. 7.—Immediately After Second Moult (Natural Size).

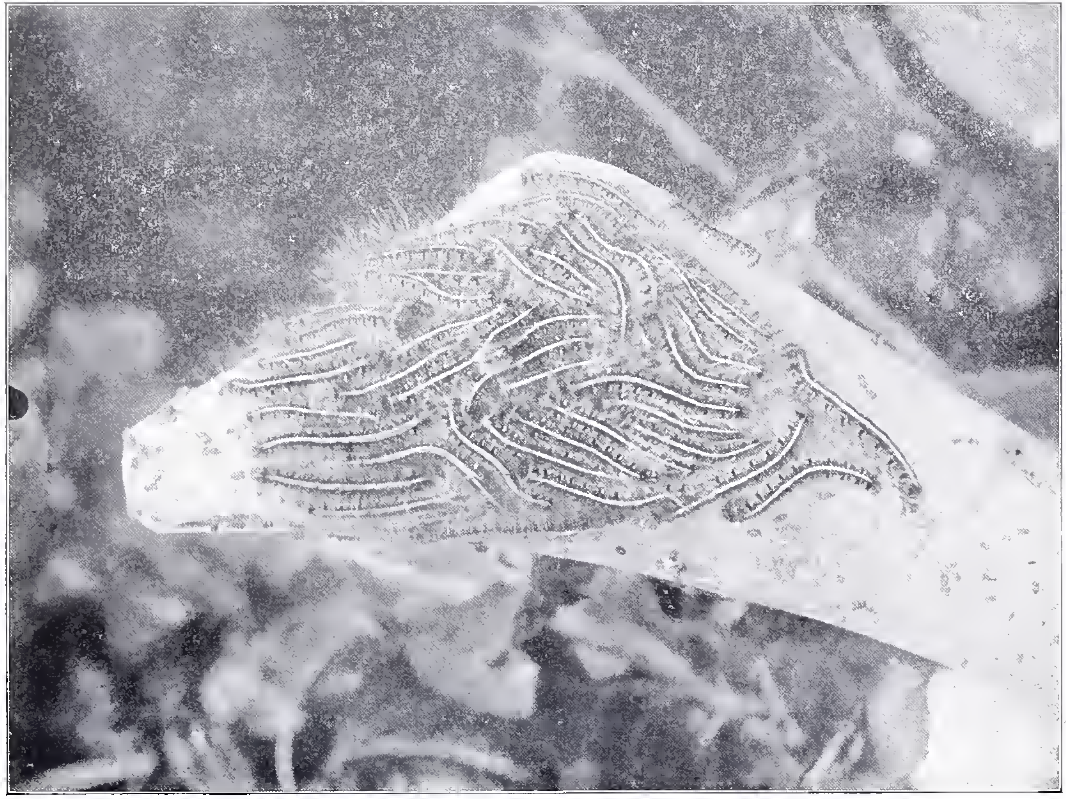


Fig. 8.—Immediately after Third Moult (Natural Size).

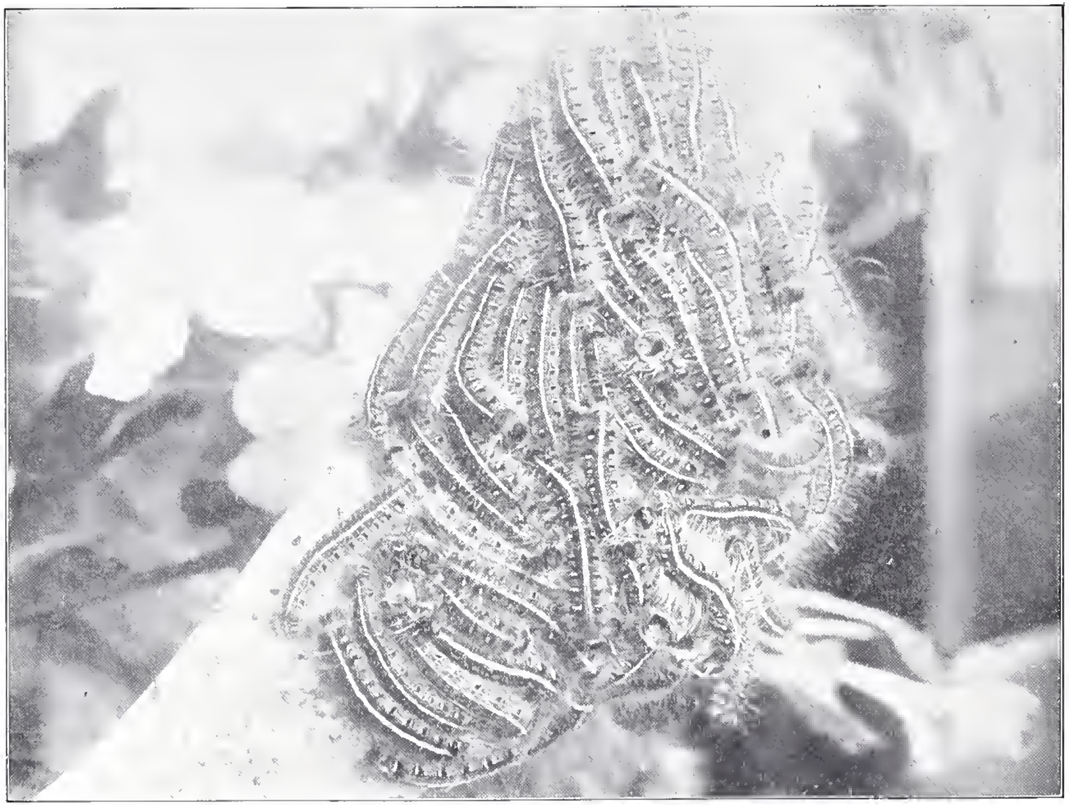


Fig. 9.—During Fourth Moult (Natural Size).

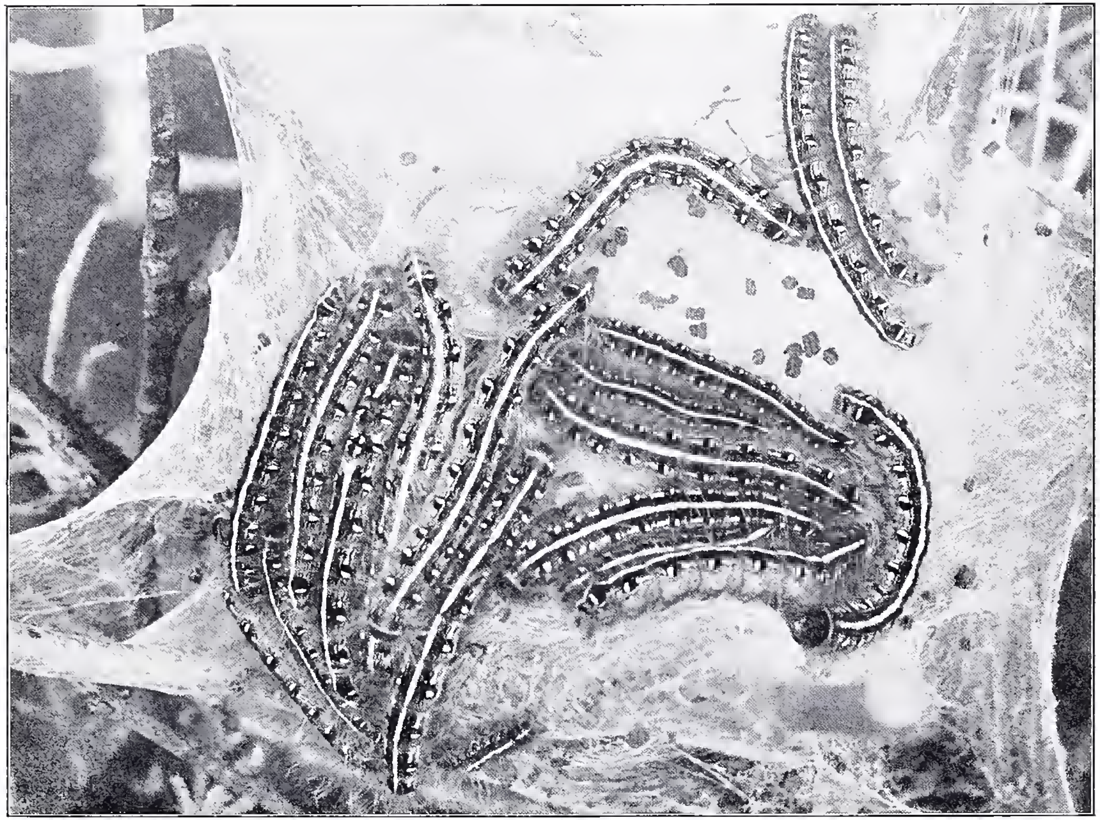


Fig. 10.—Full Grown Caterpillars (Natural Size).

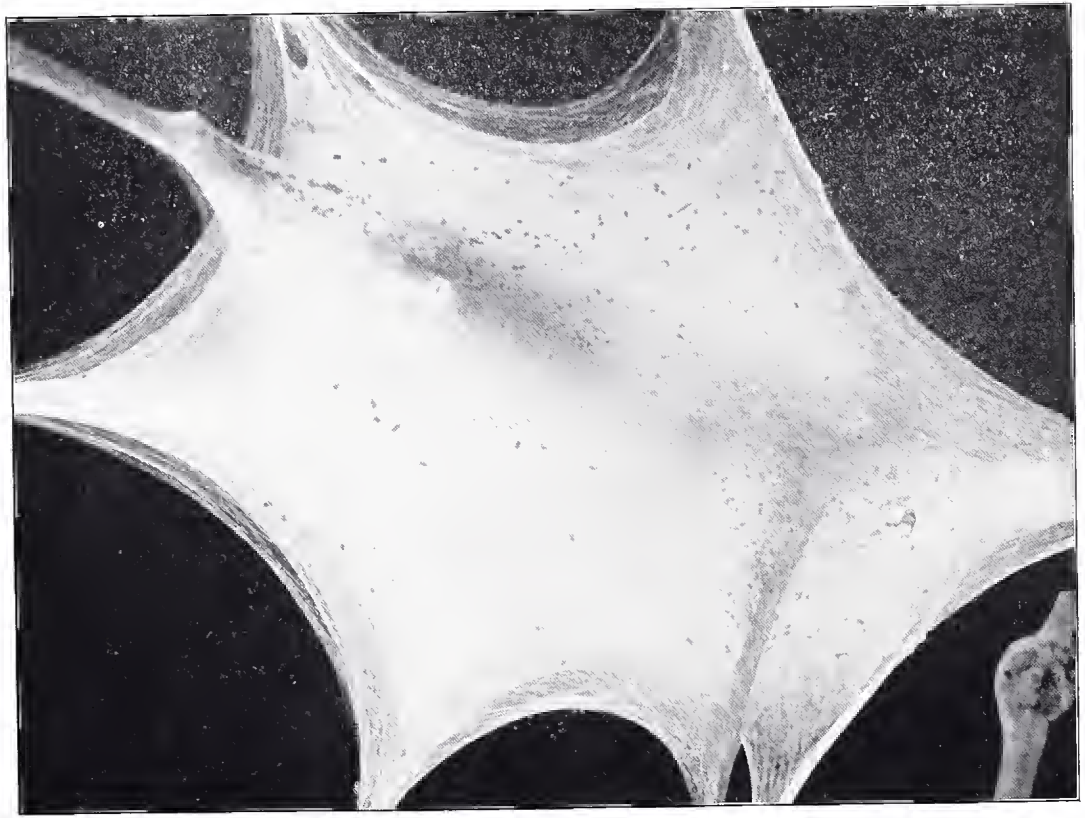


Fig. 11.—Typical Tent (One-half Natural Size).

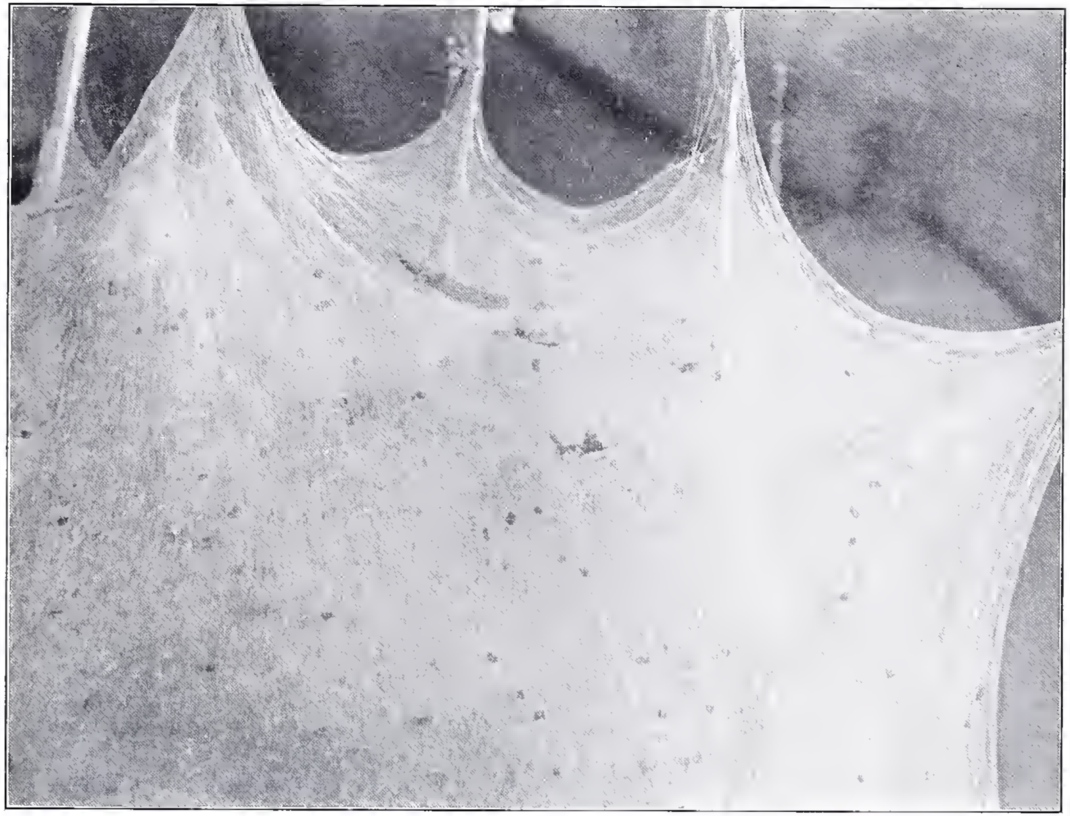


Fig. 12.—Tent Showing Layers (Reduced).

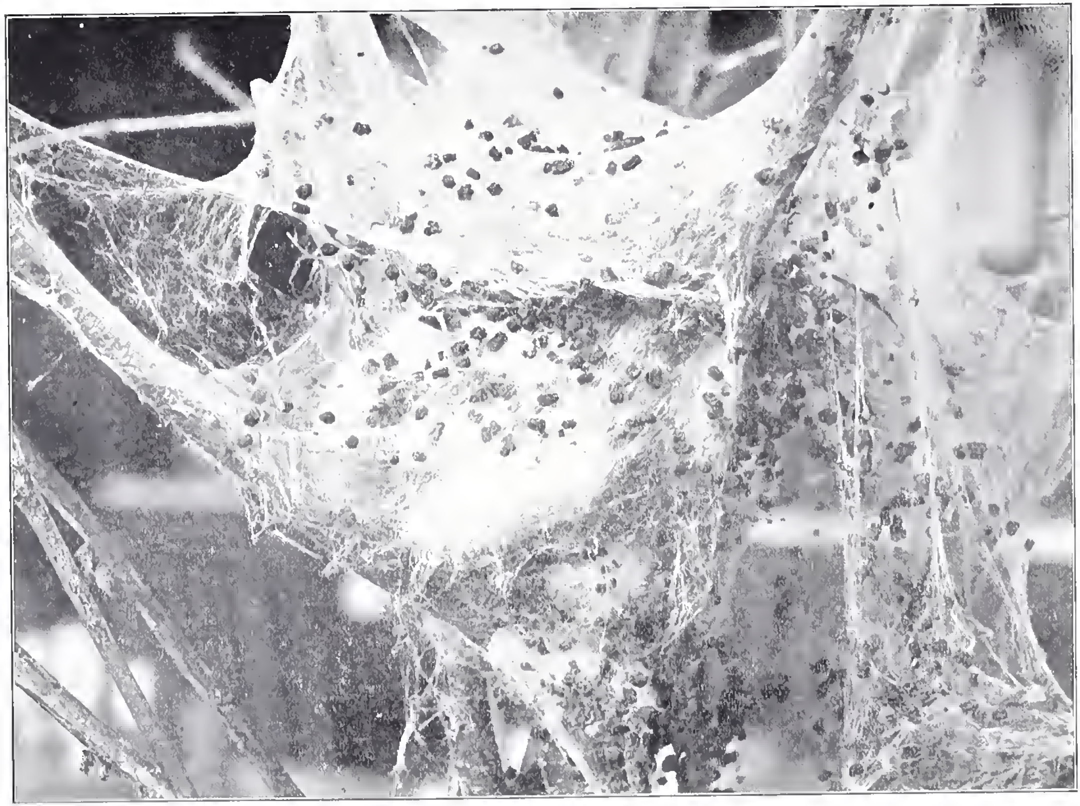


Fig. 13.—Cocoons in Tent (Natural Size).

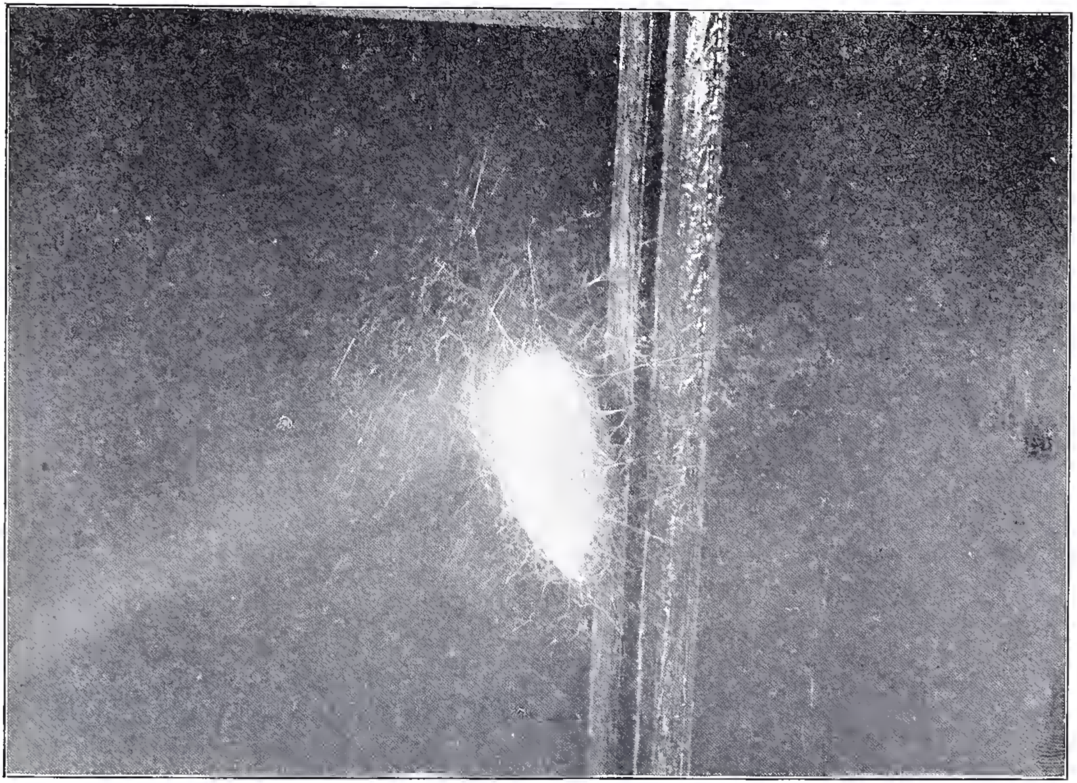


Fig. 14.—Typical Cocoon (Natural Size).

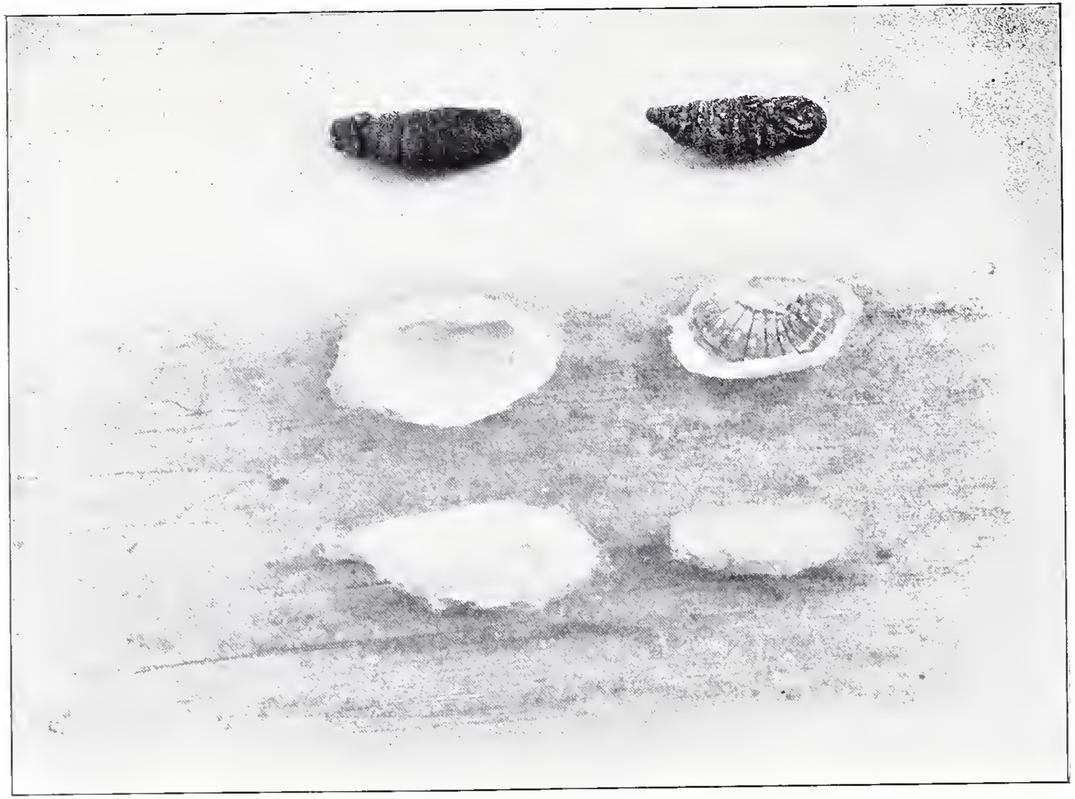


Fig. 15.—Cocoons and Pupae (Natural Size).

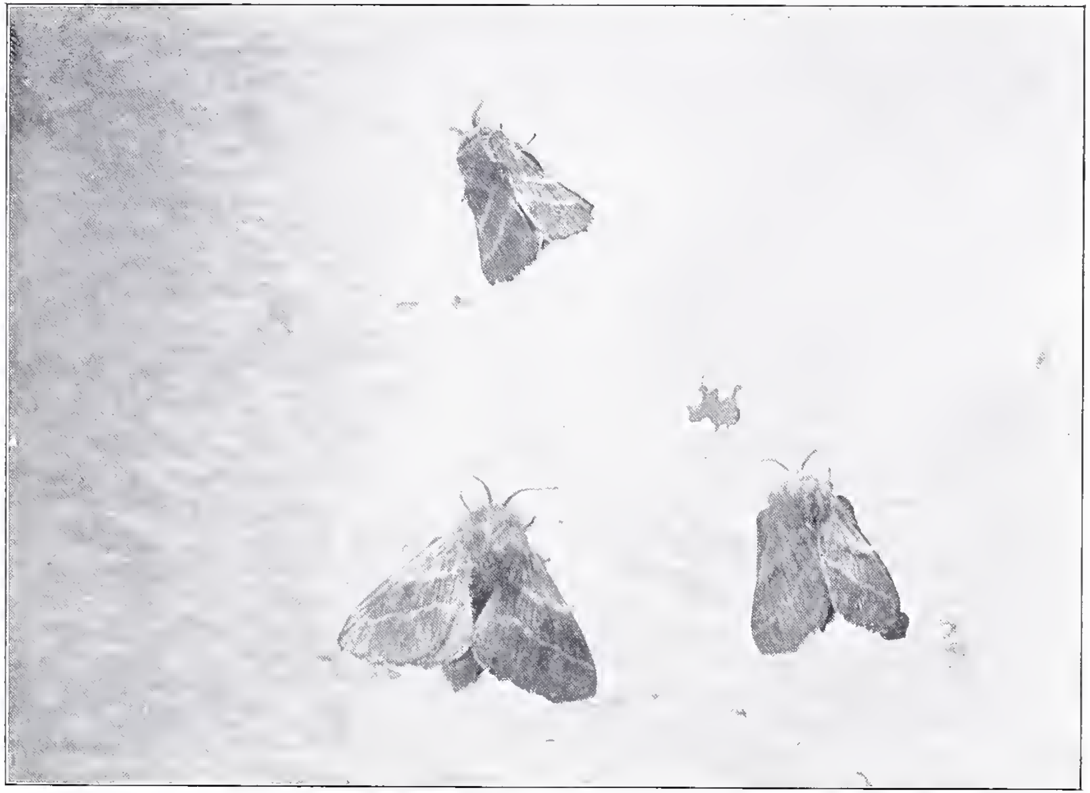


Fig. 16.—Adult Moths (Natural Size).

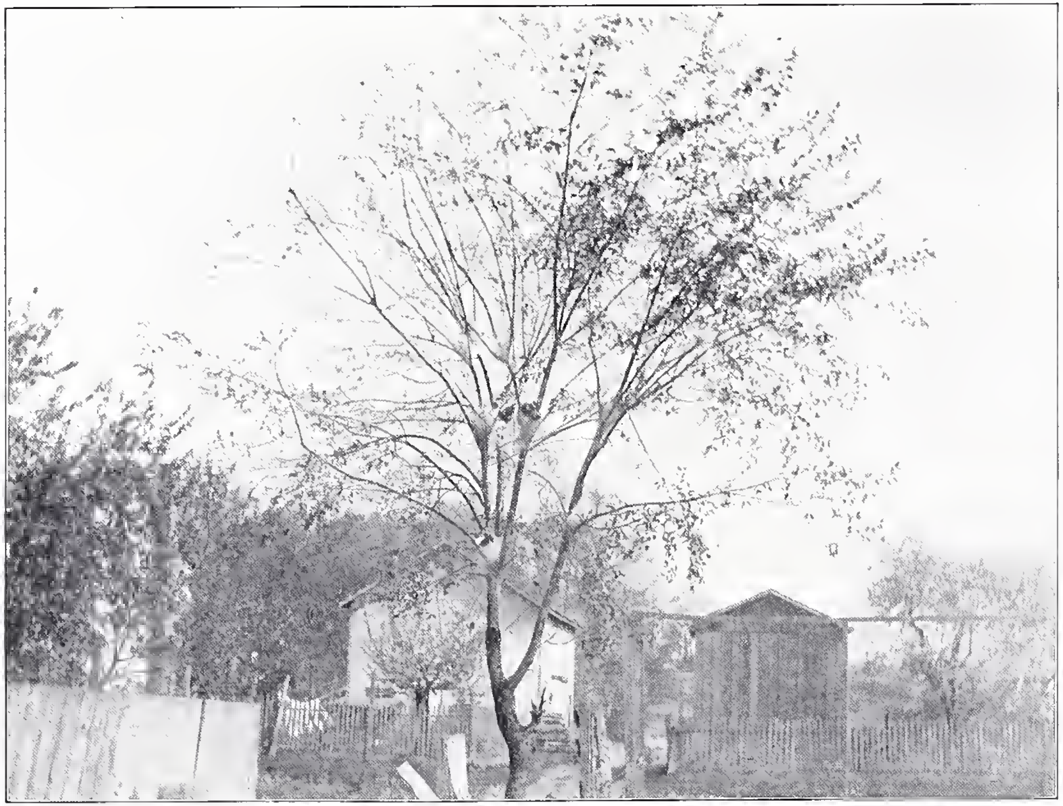


Fig. 17.—Wild-cherry Tree Attacked by Caterpillars.

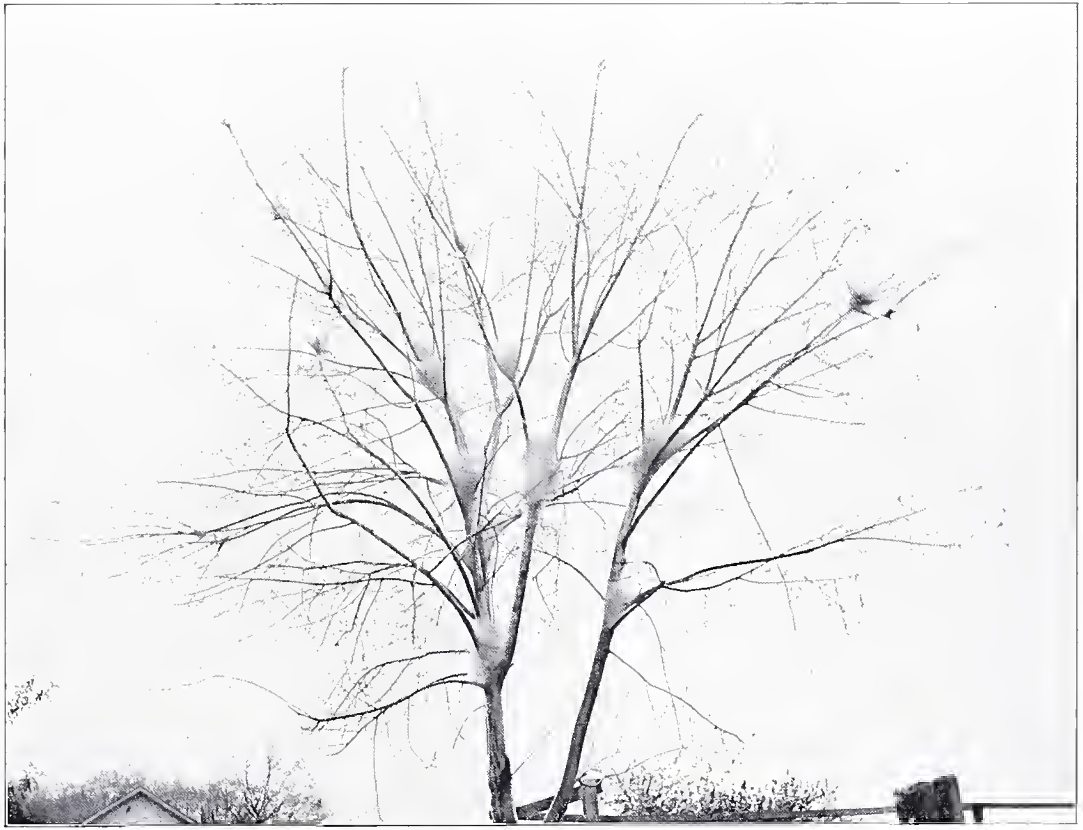


Fig. 18.—Foliage Entirely Destroyed by Caterpillars.

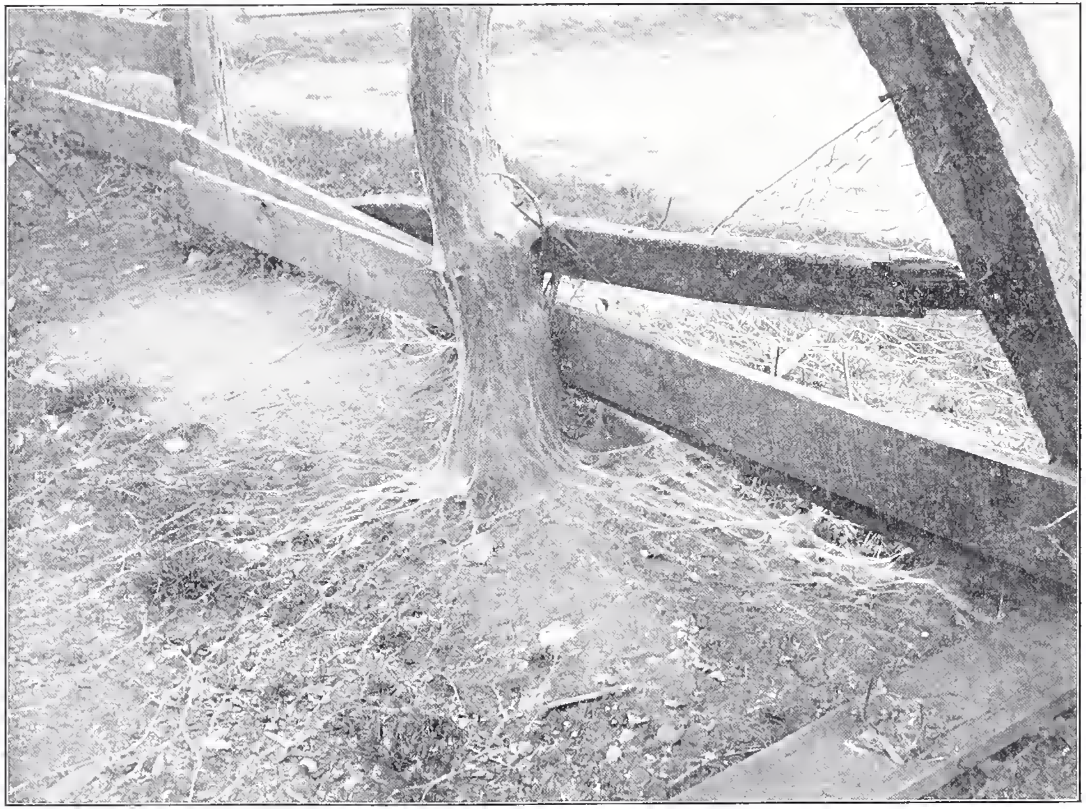


Fig. 19.—Trails Left by Caterpillars as They Abandoned the Tree in Search of Food.

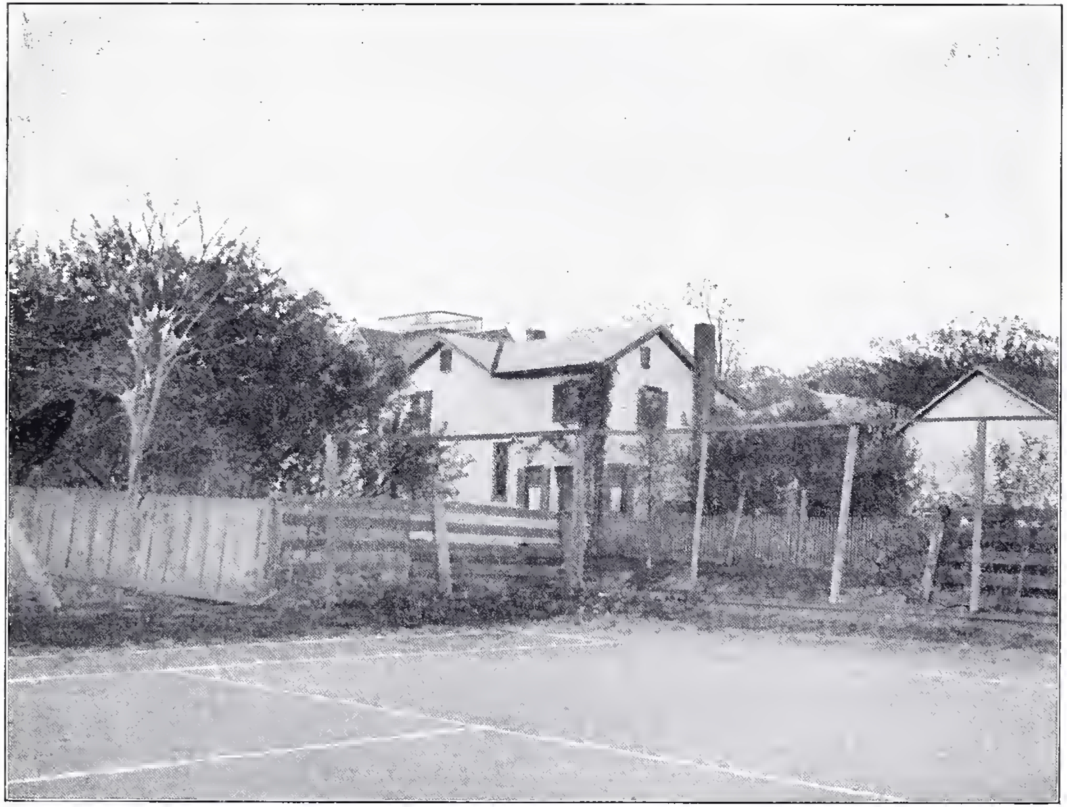


Fig. 20.—Surroundings Showing where Caterpillars went After Abandoning Tree.

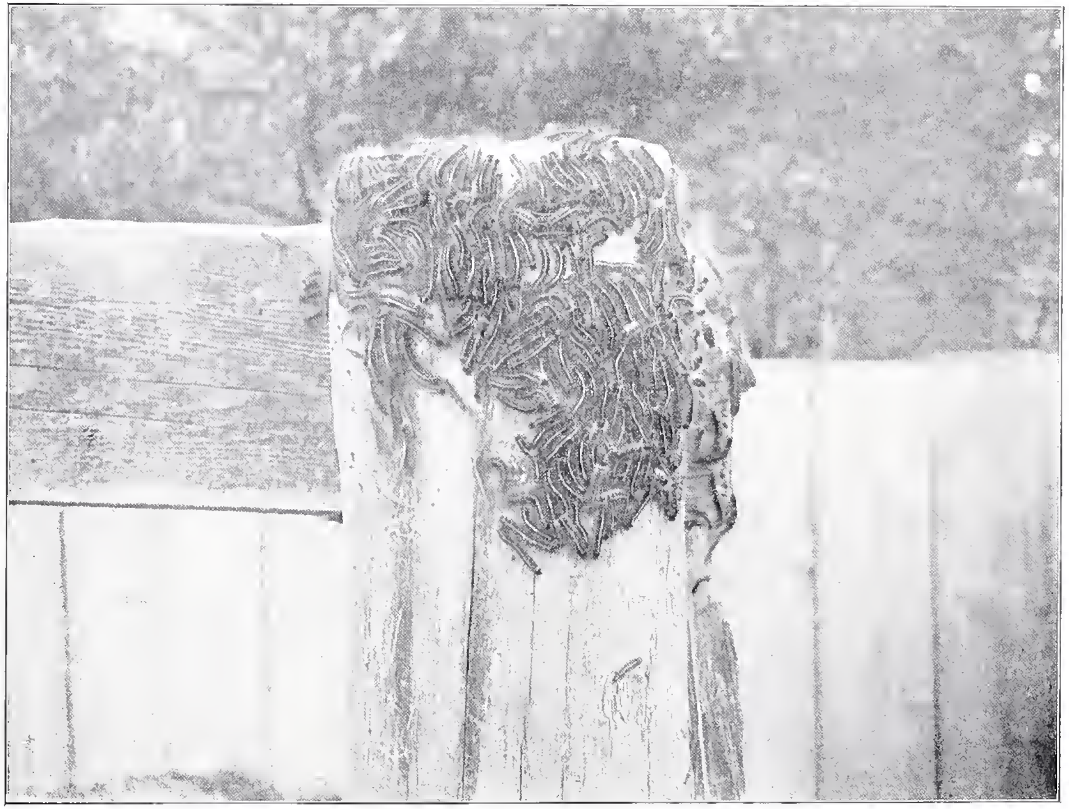


Fig. 21.—Caterpillars on Post.

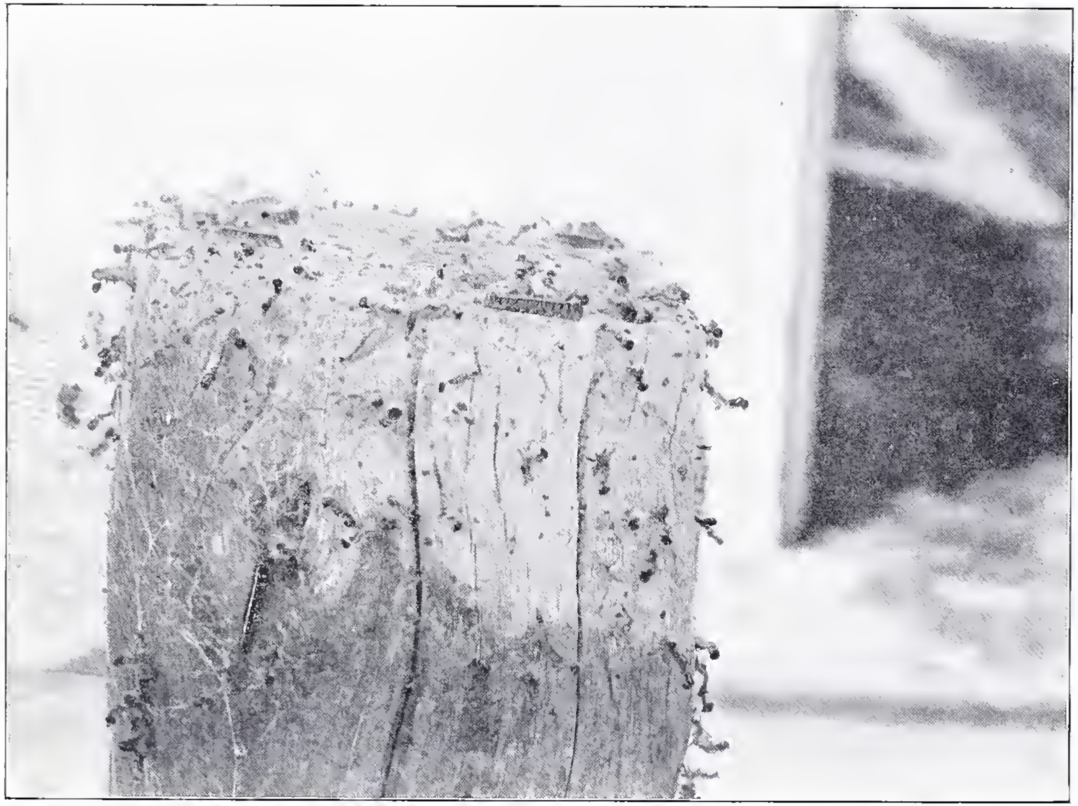


Fig. 22.—Old Moults on Post (Reduced).

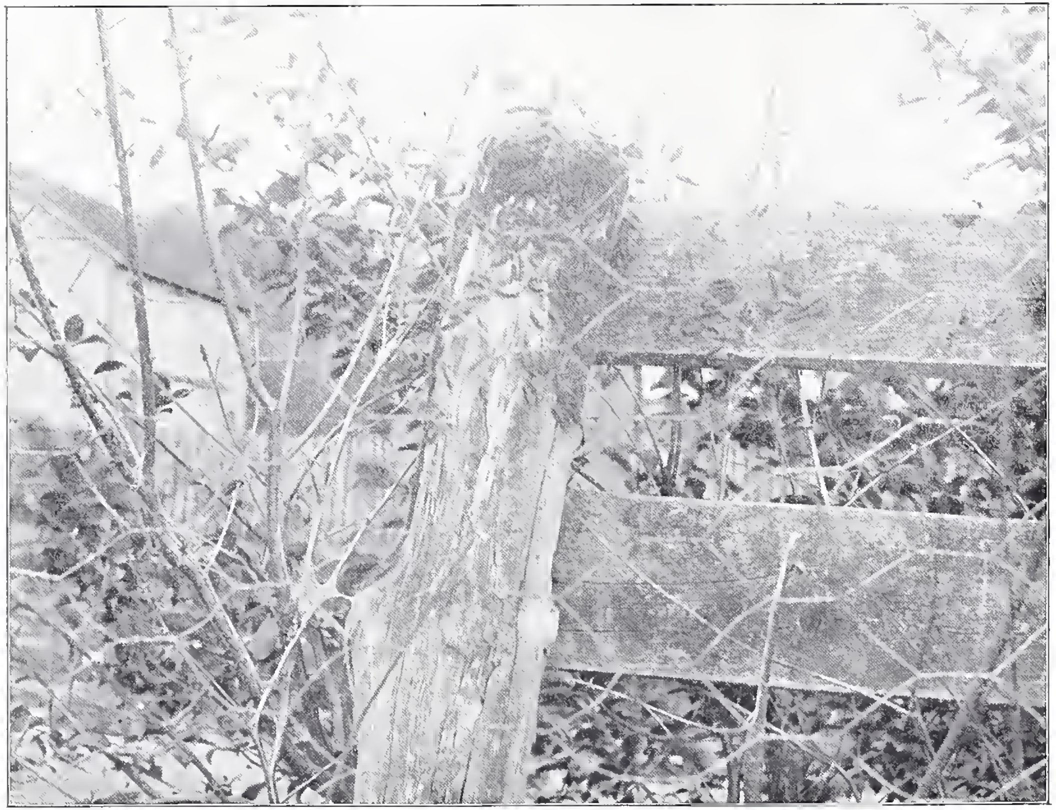


Fig. 23.—Caterpillars on Post.

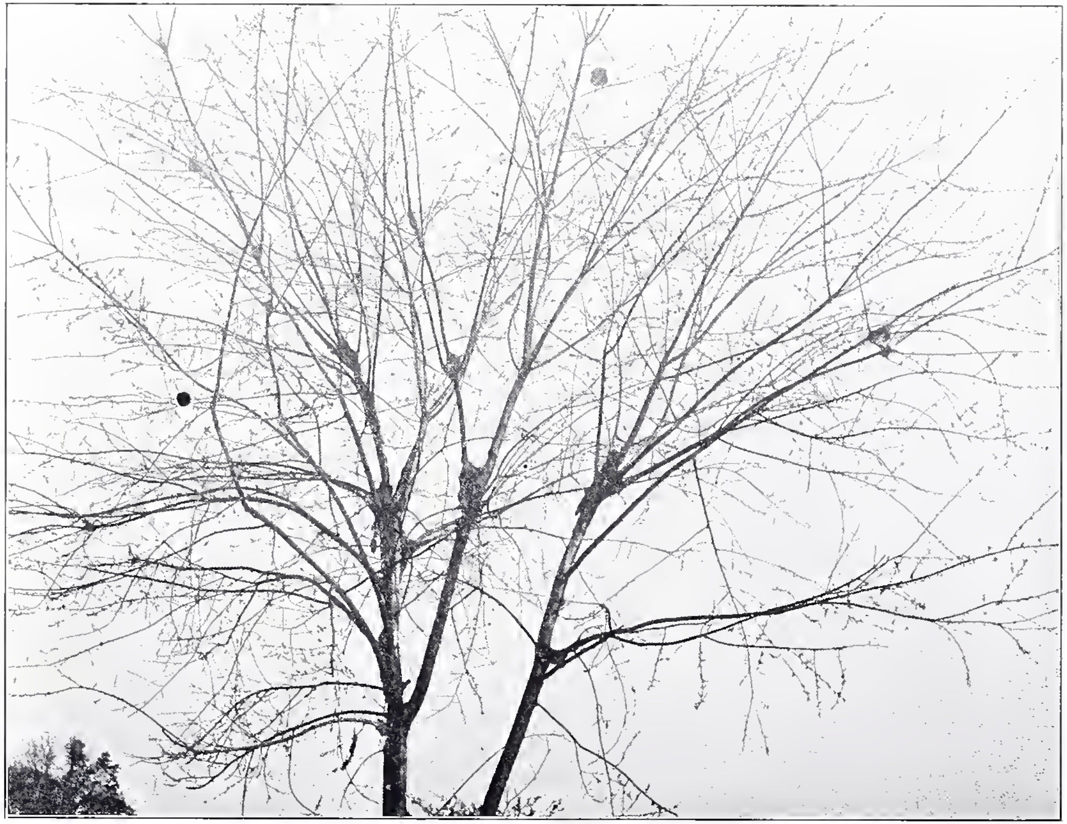


Fig. 24.—Tents Burned After Caterpillars Left Tree.

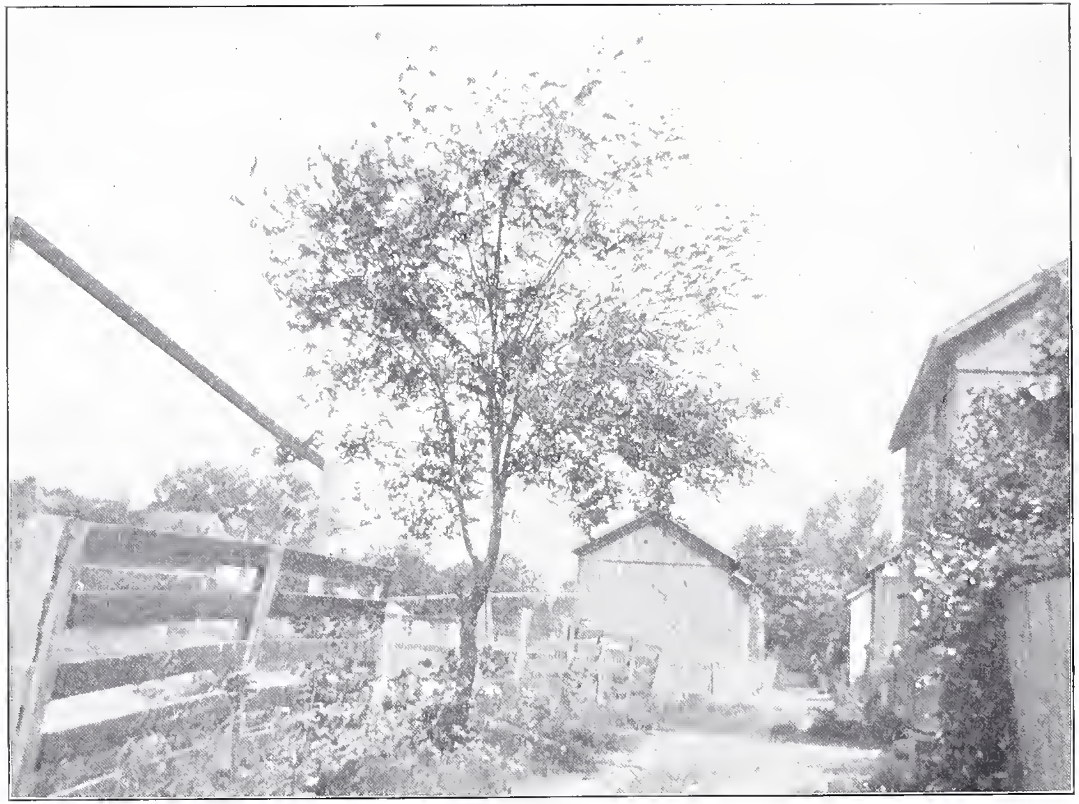


Fig. 25.—Tree Recovering from Attack of Caterpillars, July, 1902.

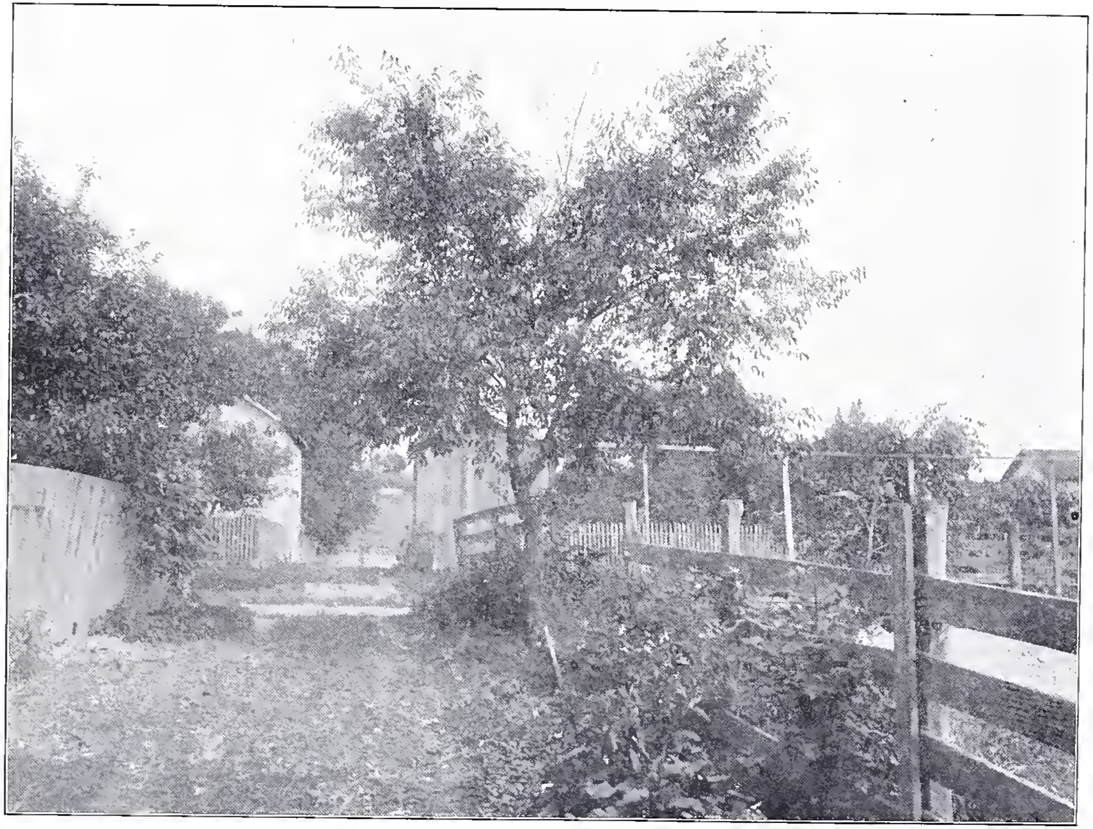


Fig. 26.—Top of Tree Dead from Effects of Burning Tents, June, 1903.

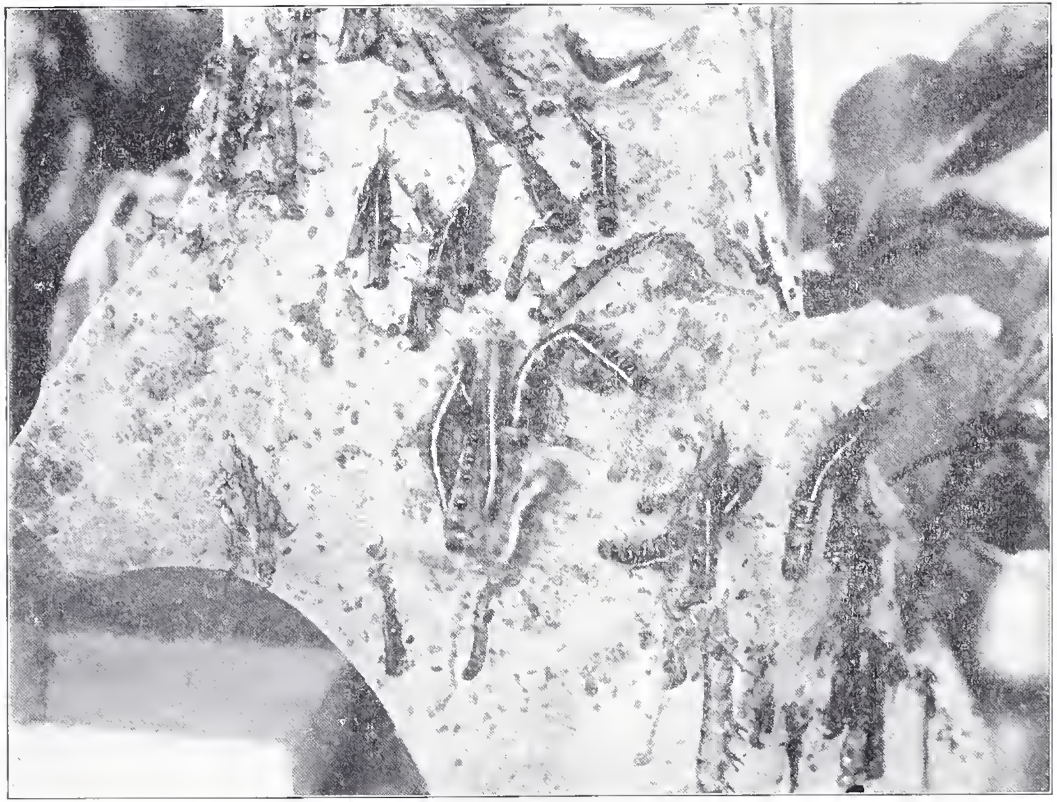


Fig. 27.—Caterpillars Dead from Disease (Natural Size).

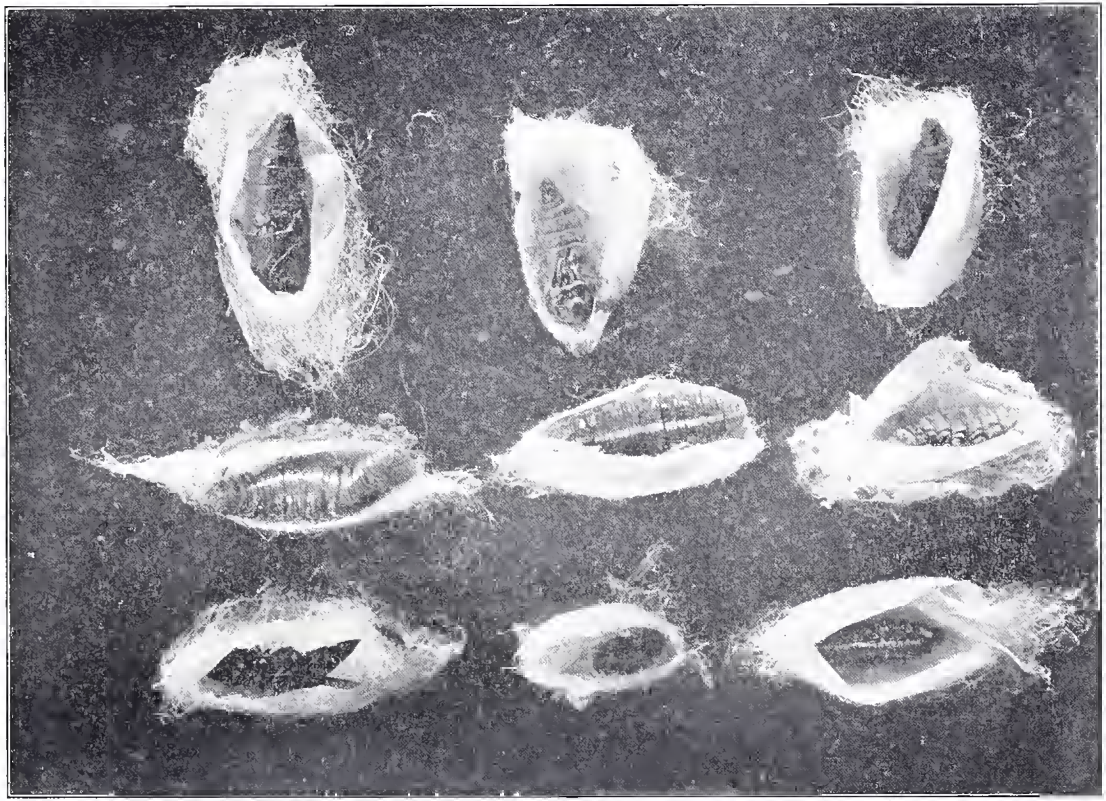


Fig. 28.—Caterpillars and Pupae Dead from Disease (Natural Size).

COMMONWEALTH OF PENNSYLVANIA.

DEPARTMENT OF AGRICULTURE.

BULLETIN No. 120.

THE APPLE-TREE TENT-CATERPILLAR

AND ITS

LIFE HISTORY.

By Nelson F. Davis, Sc. D.

PUBLISHED BY DIRECTION OF THE SECRETARY.

1903.

WM. STANLEY RAY,
STATE PRINTER OF PENNSYLVANIA.
1904.

[illegible] H

6